Assessment of Wild Mustard (*Sinapis arvensis* L.) Resistance to ALS-inhibiting Herbicides

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Introduction

● Repeated applications of herbicides with the same mode of action have resulted in weeds developing resistance. Wild mustard (*Sinapis arvensis* L.) is a common weed in field crops in the Canadian prairies and resistance to ALS-inhibiting herbicides has been reported for a number of wild mustard populations [1].

There is an urgent need for tests that can determine if weeds surviving a herbicide application are resistant. The whole-plant pot assay conducted in a greenhouse (ca. 4-6 week duration) is the most frequently used method for identifying herbicide-resistant weeds [1],

Objectives

The objectives were to develop a rapid and simple bioassay technique for assessment of wild mustard susceptibility/resistance to ALS-inhibiting herbicides.

Materials and Methods

● Seeds of 15 wild mustard biotypes that were characterized as ALS herbicide-susceptible and -resistant based on pot assays (Table 1) were obtained from AAFC in Saskatoon, SK.

● Bioassay was performed in 2-oz WhirlPak™ bags [2]. Plants were grown for 4 days and roots were measured after the bag was opened and soil washed away with water.

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Fig. 1. Mustard bioassay performed in WhirlPak® bags.

Results

Selected susceptible wild mustard biotypes showed log-logistic response, while resistant biotypes did not exhibit sensitivity to flucarbazone (0 to 15 ppb), pyroxsulam (0 to 3.45 ppb), imazamox/imazethapyr (0 to 22.4 ppb), and metsulfuron (0 to 3.2 ppb) base (Fig. 2).

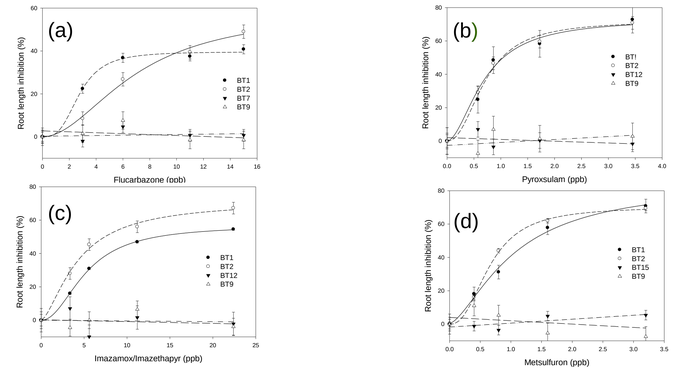

Fig. 2. Dose-response of wild mustard to (a) flucarbazone, (b) pyroxsulam, (c) imazamox/imazethapyr, and (d) metsulfuron determined by the root length inhibition bioassay.

Testing susceptibility/resistance of wild mustard populations was accomplished by growing mustard plants in the untreated soil and in the herbicide-treated soil at 15 ppb flucarbazone, 3.45 ppb pyroxsulam, 22.4 ppb imazamox/imazethapyr, and metsulfuron at 3.2 ppb (Table 1).

Table 1. Susceptibility/resistance or wild mustard biotypes from pot assays and estimated percentage of resistant plants in wild mustard populations in response to selected ALS-inhibiting herbicides.

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Wild mustard biotype	Data on susceptibility/resistance from pot assays	% resistance to ALS-inhibiting herbicides[c]			
		Flucarbazone	Pyroxasulfone	Imazamox/ Imazethapyr	Metsulfuron
BT1	Susceptible to Refine[a]	0	0	0	0
BT2	Susceptible to Refine	0	0	0	0
BT3	Susceptible to Refine	60	0	0	0
BT4	Susceptible to Pursuit[b]	100	10	15	15
BT5	Susceptible to Pursuit Susceptible to Odyssey[b]	0	0	0	0
BT6	Susceptible to Refine	0	0	0	0
BT7	Strong resistance to Muster[a] Strong resistance to Refine	100	-	-	-
BT8	89% resistant to Pursuit	100	100	100	0
BT9	100% resistant to Odyssey 100% resistant to Refine	100	100	100	100
BT10	100% resistant to Odyssey 100% resistant to Refine	100	100	100	100
BT11	90% resistant to Odyssey 50% resistant to Refine	100	100	100	100
BT12	100% resistant to Odyssey 100% resistant to Pursuit 100% susceptible to Refine	100	100	100	0
BT13	100% resistant to Solo[b] 100% resistant to Beyond[b]	100	100	100	0
BT14	100% resistant to Odyssey	100	100	100	100
BT15	98% resistant to Pursuit 8% resistant to Refine	100	100	100	70

[a]Refine and Muster are sulfonylurea (SU) herbicides.
[b]Pursuit, Odyssey, Solo and Beyond are imidazolinone (IMI) herbicides,
[c] % resistance = number of uninhibited roots/total number of roots × 100 % in response to flucarbazone at 15 ppb, pyroxsulam at 3.45 ppb, imazamox/imazetapyr at 22.4 ppb, and metsulfuron at 3.2 ppb;

Conclusions

● The root length bioassay is suitable for assessment of susceptibility/resistance of wild mustard populations to ALS-inhibiting herbicides.

● To perform this bioassay, no specialized equipment is required and the bioassay is completed in 6 days. Seeds are pre-germinated for 2 days, and plants are grown for 4 days in a laboratory under fluorescent light in plastic bags filled with untreated soil and herbicide-treated soil

● Due to variability in root growth, a minimum of three replications of plants grown in the untreated and in herbicide-treated soil, i.e. a total of six WhirlPak® bags seeded with plants are recommended.

● Susceptibility/resistance is estimated by calculating the percentage of uninhibited roots of plants grown in the herbicide-treated soil as compared to the plants grown in the untreated soil.

● Testing susceptibility/resistance to herbicides from each class of the ALS-inhibitors is required as wild mustard biotypes may be resistant to one class but susceptible to another.

● This simple and rapid (6-day) root length bioassay performed in a laboratory can be used in place of the whole-plant pot assay conducted in a greenhouse that requires ca. 4-6 weeks for the assessment of wild mustard resistance to ALS-inhibiting herbicides.

Acknowledgements

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References

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